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We have for several years entertained a favorable opinion regarding the advisability of establishing a well equipped observatory for the almost exclusive purpose of astronomical discovery. One has only to recount the labors of American astronomers during a brief term of years to remark the great advancement of their science, which has resulted from the direction of energy toward this end. Professor Bond's discovery of a new satellite and a dusky ring to the planet Saturn; Mr. Burnham's well-known discoveries of new double stars; the discovery of the companion of the bright star Sirius by Mr. Alvan G. Clark; the discovery of fifty or sixty small planets between Mars and Jupiter by Dr. Peters and Professor Watson; the independent discovery of three or four comets by Professor Swift; the discoveries of intra-Mercurial planets, at the time of the eclipse of 1878, by Professors Watson and Swift; the extraordinary discovery of the two satellites of Mars by Professor Hall; the brilliant spectroscopic discoveries by Dr. Henry Draper of the existence of oxygen in the sun, and of the inherent heat of the planet Jupiter—are recalled at once. We might add greatly to the list without difficulty; but that is not necessary for the support of the belief that astronomers have not discovered all there is to discover in the solar system even, although their labors have been very arduous, and their means of research most powerful. We should be inclined to predict a scientific record of great importance and usefulness for any observatory of high instrumental capacity, which should set out upon a line of systematic observation, with reference to astronomical discovery simply. It is gratifying, therefore, to learn that the new observatory, now in process of erection at Rochester, N. Y., would seem to be dedicated to this sort of work. Professor Lewis Swift, of that place, has, we believe, 'been installed the life director of that institution, constructing and endowed by the munificence of Mr. H. H. Warner, an enterprising merchant of Rochester, and entitled, from its founder, the Warner Observatory. About $50,000 will be expended in the construction of the observatory proper, and the connected structure. The Messrs. Clark, of Cambridgeport, are now making a large refracting telescope (aperture of the object-glass, sixteen inches) for this new observatory. We regret that, in the proposed construction of this edifice, the architect should, in some measure, have resorted to the former system of building observatories—that of mounting the great telescope upon a pier of masonry built high up from the surface of the ground. A series of properly conducted experiments will usually indicate, however, whether this method is free from objection in any particular case. We note a connected contrivance—hitherto unknown in astronomy—a passenger-elevator to the floor of the dome. We shall express the hope that the abundance of new devices with which this new observatory is to be supplied may not be marked, as is frequently the case, by a less amount of good astronomical work than is performed in observatories of like capacity, where nothing is for convenience and everything for pure utility.

A lecture on "Microphysiology" was recently delivered before the Polytechnic Association of New York, by a person having an unenviable reputation for making extravagant assertions on scientific questions. It has been widely reported by the public press, and we notice that a claim is made that the origin of Bacteria and minute forms of life in the atmosphere has been discovered by the lecturer.

It was also asserted at the same time that microscopical organisms can be developed in the laboratory under conditions which exclude atmospheric contact, a fact in direct contradiction to the exhaustive experiments of Tyndall and others.

The problems thus professed to be solved have defied the intelligent research of such men as Huxley, Dallinger, Beale, Sanderman and Bastian, aided by the most powerful and perfect objectives obtainable. The present assertions to the contrary will, therefore, be received with humor by those acquainted with the subject, if the mischief caused by such reckless statements be not considered.

The announcement made at the same time of the discovery, by the lecturer, of a new form of objective, the extended application of which nearly doubles the present limit of the magnifying power of microscopical objectives, requires but a passing notice.

This individual appears to have fallen into the error of supposing that the excellence of a microscope is

to be determined by the greatness of its magnifying power. On the contrary that instrument must be considered the most efficient which renders the details of an object perceptible with the lowest power. Destinctness of definition, by which is meant the power of rendering all the minute lineaments clearly seen, is a quality of greater importance than mere magnifying power. Indeed, without this quality mere magnifying power ceases to have any value.

At present there is an honorable competition between Spencer and Tolles, of America, Powell and Lealend, of England, and Zeiss, of Germany, as to who shall produce the most perfect microscopal objectives; and it would be a difficult matter to decide which of these firms possesses the greatest merit in workmanship. Zeiss, with his oil immersion system, may have obtained the credit of a temporary advantage, but similar forms of objectives are now being manufactured in this and other countries with success.

These makers are bringing to bear on their work all the most recent discoveries in optical science, and if any advance is made in the magnifying power of objectives, we shall expect to find it produced by such skilled opticians.

PALÆONTOLOGICAL RESEARCHES.

By Prof. Henry S. Williams, Ph. D., Cornell University.

I.

Genesee Slate. Fauna and Flora of Station xxxiv. d., H. S. W.

On the eastern shore of Cayuga Lake, N. Y., near the head, is a fine exposure of the boundary strata of the Hamilton and Chemung periods. Careful examination has been made of the upper part of the Genesee slate as it occurs in Burdick's Ravine, the face of the high fall. (Station xxxiv. H. S. W.) Here the lowest Portage sandstone lies about 60 feet above the surface of the lake, and the characteristic Genesee slate follows immediately under it. The following species were obtained in the slate between four and five feet below the sandstone stratum, forming the base of the Portage group:

Discina lodensis, Van.—abundant.
Discina truncata, Hall—frequent.
Lingula spatulata, Van.
Lingula concentrica—(of Vanuxem's Rep't, but not Conrad's species). See beyond.
Tentaculites (*Styliola*) *fissurella H.* — abundant. (See beyond).
Tentaculites gracilistriatus, H.
Leiorhynchus quadricostatus, Van.
Chonetes lepida, Hall.
Aviculopecten fragilis, Hall.
Orthoceras—(subulatum ?).
Ambocœlia umbonata, Con.
Avicula speciosa, Hall.
Impression of part of *Goniatites?*.
Plants, three well marked forms.

This fauna has several interesting forms in it.

The recurrence of Marcellus forms noticed by Hall, in Geol. 4th Dist. N. Y., p. 222, 1843, is seen to be more marked than was observed by him.

The *Tentaculites fissurella*, Hall, may prove to be *Styliola* (*Les.*) but if so, the same form is repeated in the Genesee slate from the Marcellus shale.

It is difficult to be satisfied with the recognition of this form as *Styliola*, since annulated forms occur together with the smooth ones, and except in the annulations are not to be separated from the true *Styliola* forms. The shells are very frail and crushing may account for the longitudinal folds in part, as it does in some of the Orthoceratidæ.

This fact is noticed by Hall in the Marcellus forms (in Illustrations Der. Fossils, Pl. xxvi.) and the "prevailing form," fig. 14, is the prevailing form in the Genesee, and among the specimens just collected the annulated forms do not differ in size from the smooth ones, and the latter are often larger.

Discina lodensis, Van. occurs in abundance, and with some variation, but the form called *D. truncata, H.* is distinct and does not show gradation into the former. Still this is also distinct from the Lingula which Vanuxem figured, but did not describe in Geol. of 3d Dist., N. Y., p. 168, fig. 4. Vanuxem refers the species to Conrad's *Lingula concentrica*, which is evidently a mistake, since Conrad's species, *L. concentrica*, is from the Helderberg mountain, in limestone, and is $\frac{3}{4}$ inch long (see Geol. Rep't, N. Y., 1839, p. 64). The species found in association with *L. spatulata* is nearly 5 millemetres long and 3.3^{mm} broad, and the cardinal margin is broadly, evenly rounded, and not attenuated as in *spatulata*.

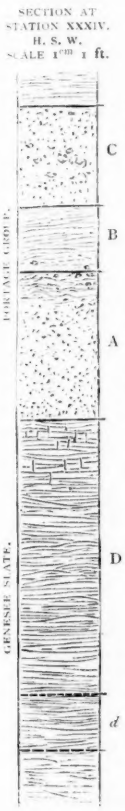
L. spatulata, Van. is nearer the size figured by both Hall and Vanuxem (from 4 to 4.5^{mm}) instead of approaching 7.5^{mm} ($\frac{3}{10}$ inch) as stated by Hall in the description (Pal. of N. Y., vol. 4, p. 13). These are of the ordinary size of *Lingula spatulata, Van.* as they have been observed by the author. The *Lingula concentrica* (of Van. not Con.), is distinguished from the *Discina truncata* by the absence of the indentation or truncation, and the extension of the margin beyond the umbo, as well as other characters not as easily observed.

The Chonetes found is distinctly the *Chonetes lepida* of Hall, and not *setigera*. Still this may prove a variety of *setigera* upon further study; the two occur together in the Moscow shales and Marcellus, and in other strata of the Hamilton.

Only a single specimen of *Aviculopecten fragilis* was found, but this distinct and characteristic.

Ambocœlia umbonata, Con. was found in several beautifully preserved specimens.

And one of the dorsal valves is marked on the outer surface by concentric rows of minute short interrupted radiating lines, and when magnified resembles very closely the figure of *Spirifer prematura* on plate 33 of Hall's Pal., of N. Y., Pal. 4, fig. 32. Further study of these forms will probably develope interesting facts.



Avicula speciosa, Hall. This species is represented by several specimens small and large, some of quite large size, but showing the characteristics of the Portage representatives.

This fact is especially interesting as the form has not been recorded from outside Portage rocks, and though this stratum is but a few feet below the base of the Portage, it is distinctly below and in the midst of characteristic Genesee slate.

It will be observed that this brings the species into the Hamilton Period. There are also some well marked plant-remains, one linear grass-like form, another sturdy branching form the relations of which have not been made out.

The dip of the base of the Portage in one direction was determined. Three stations were examined a thousand feet apart, and in nearly a straight line running North and South, and the elevation of the base of the stratum A of the Portage determined relative to the level of the lake.

St. XXXII.	base of A above lake level.....	7	ft.
" XXXIII.	" " "	35½	"
" XXXIV.	" " "	57.9	"

These being 1000 feet apart, the dip is nearly 51 feet in 2000 feet.

The first 1000 feet showing 28½ feet and the second 1000 feet showing 22½ feet nearly. Thus the dip is not uniform, a fact further shown by a study of the rocks further South where the dip is much less, as was determined by careful survey of strata near the top of the Portage.

The accompanying diagram shows the general nature of the section at the three stations XXXII., XXXIII., and XXXIV. The scale is one centimeter to the foot. C and A and lower part of B contain concretionary nodules of iron pyrites; A and C, sandstones, are separated by the shale B, which is more or less arenacious and differs decidedly from the Genesee slate below, which is the characteristic mud shale, black, and very fine in texture with arenaceous streaks in it toward the top.

The fossiliferous stratum whose fauna is described, is *d*, lithologically scarcely defined from the shales above and below.

THE TELEPHONE AMONG THE INDIANS.

The United States Fish Commission has lately connected, by telephone, its Salmon Hatching Stations at Baird, on the McCloud river, California, with the establishment for breeding the California trout five miles further up the river, and the apparatus is now in thoroughly good working order. The Indians look on in blank amazement and call the instrument the *Klesch-teen*, or speaking spirit.

A REMARKABLE METEOR.

By Edwin F. Sawyer.

While engaged in recording meteors on the evening of Oct. 9th, I observed a very remarkable one at 10 h. 25 m. C. M. T., low down in the east, which calls for special mention. My attention was first attracted to what appeared a stationary meteor > 1 mag. near γ (Gamma) Orionis, and of a deep orange color. While noting its accurate position, the meteor very slowly (motion hardly perceptible) began to descend towards the horizon, where it disappeared behind some houses. It remained perfectly stationary for at least a second after it was first observed, and it occupied 6 seconds in traversing an observed path of 10°. The meteor's brightness decreased slowly as it approached the point of disappearance being at this point of the 3d mag. No streak was observed. The exact point of appearance was at R.A. 76°+5° and it vanished at R.A. 76½°—5° near β Orioms (Rigel). Duplicate observations of this meteor would be of value.

Cambridgeport, Mass., Oct. 10, 1880.

THE "YELLOWS" OF THE PEACH TREE.

By Prof. T. J. Burrill, Illinois Industrial University.

A peculiar disease of the peach tree known as the "yellows," has long been the scourge of the principal peach growing districts of our country. Its appearance somewhat recently, in Michigan, caused much alarm, and since its occurrence throughout great orchards in some of the best fruit districts of the State, special attention has been called to it.

In "Science" for September 25th, 1880, page 162, there appeared an abstract of a paper read by me before the American Society of Microscopists at Detroit, upon the blight of pear and apple trees. In this paper I expressed the opinion that the "yellows" of the peach tree would be found due to an organism similar to that found to be the cause of the pear tree blight. This opinion was based upon my knowledge of the latter disease, upon the thoroughly confirmed contagious character of the "yellows," and upon the failure of competent investigators to find, after extended re-

search, any thing like the ordinary parasitic fungi. It was long ago conceded by entomologists that the disease did not arise from the depredations of insects.

I am now able to confidently assert that this devastating disease of the peach is caused by Bacteria!

These minute, moving, living things are found in great numbers within the cells of the diseased tree. They are apparently specifically different from those of the pear tree, being comparatively much more slender. What I take to be the typical form—all vary considerably—is very nearly 1 μ by 3.5 μ (.0000343 in. by .0001202 in.), made up of several not very evident articulations. They rest in some stages nearly or quite motionless, and in this condition show a curious peculiarity of lying in ranks, side by side. In other periods of development they move in an unsteady, undulating manner with considerable rapidity; they turn, twist and tumble on their sides, on end, now drifting with the current, now swarming in an inextricable maze in the field of a first-class one-tenth objective.

As the Bacteria increase the starch grains, stored by the tree for its own nourishment disappear, and I doubt not further investigation will prove that, as in the blight of the pear and apple, butyric fermentation takes place. The diseased tree probably suffers in other ways from the presence of these minute parasites, but we may say with truth that it really starves to death. Its food, gathered from the earth and air, assimilated by the leaves and stored for immediate or future use, is ruthlessly seized upon and destroyed. No doubt this takes place at all times of the year, when the temperature of the surrounding air is considerably above the freezing point; but the Bacteria are probably most active in the summer time.

Judging from my experiments upon the pear tree, the destroyers only gain entrance to the tissues of the tree through wounds in the epidermis or bark; but it is possible that at the time of flowering they penetrate by way of the stigma, which is not protected by an impervious coating.

The cellulose tissue of the tree is not destroyed, and it is still a puzzle how the Bacteria, minute as they are, pass from cell to cell. As in the pear, it is probably a very slow process, and is not connected with the circulation of fluids in the tissues.

The discovery of Bacteria as the cause of disease in plants may prove a notable contribution to the "germ theory" of disease in animals.

THE ANTIQUITY OF MAN IN EASTERN AMERICA, GEOLOGICALLY CONSIDERED.*

By HENRY CARVILL LEWIS, A. M.

In the course of an investigation of the surface geology of southeast Pennsylvania, the writer has determined some facts, regarding one of the gravels, which, bearing directly upon the antiquity of man in America, become of interest. In former papers the writer has shown that the gravels of the Delaware Valley belong to several distinct ages; and if therefore at any place the remains of man are shown to occur, it will be important to know to which of these gravels they should be referred.

The surface formations of southeast Pennsylvania may be divided into five clays and four gravels. These are, beginning with the oldest: (1) *Jurasso-cretaceous* plastic clay, seen at Turkey Hill, Bucks Co.; (2) Tertiary clays of the "*Brandon Period*," associated with the iron ore, kaolin and lignite of the Montgomery County Valley; (3) "*Bryn Mawr gravel*," often found at elevations of 400 ft., characterized by the presence of an iron conglomerate and of pebbles of Potsdam, but never of Triassic rocks, and conjectured to be late Tertiary; (4) "*Branchtown clay*" of similar age; (5) "*Glassboro' gravel*," of latest Pleiocene age, found also on the watershed in New Jersey, between the Atlantic and the Delaware, and known by its pebbles of Niagara limestone and of other fossiliferous rocks; (6) "*Philadelphia red gravel*," of Champlain age, which contains numerous boulders of all materials, fragments of Triassic rocks, etc., which shows flow-and-plunge structures and wave action on a large scale, which rests on a decomposed gneiss, and which is confined to the river valley; (7) *Philadelphia brick clay*, which, with its boulders, rests upon the last, and like it, appears to have been deposited by the waters of the melting northern glacier; (8) "*Trenton gravel*," a sandy river gravel forming the bed of the Delaware; (9) the modern *alluvial mud* now forming in the tidewater swamps.

Of these formations, one of the least conspicuous at Philadelphia is that now called the Trenton gravel. It is a true river gravel, rising here but a few feet above the water, and forming a quicksand when below water level. It is of gray color, and contains pebbles composed entirely of the rocks which form the upper valley of the river. Unlike older gravels, it has very few quartz pebbles, and its pebbles are generally flat. In the middle of the river at Philadelphia it is 100 ft. deep. On tracing this gravel up the Delaware it is found to rise higher above the river and to extend farther back from it as we proceed up stream. Thus, at Bristol it extends two miles back from the river, and is bounded by a well-marked hill, upon which rest the older gravels. At Trenton, the limit of tidewater, the narrow upland portion of the valley begins, and from there up this gravel is shallow, and confined to the river bed. The oceanic gravels trend across New Jersey, and are no more seen. Two surface formations alone remain—the river gravel of past glacial age, and the brick clay, with its boulders, of champlain age. The first lies within the last, and both can be traced up to the great terminal moraine near Belvidere. It is to be especially noted that the Trenton gravel is newer than a drift of champlain age. It is in this Trenton gravel, and in this gravel only, that traces of man are found.

The Trenton gravel at the locality which gives it its name, is remarkably well exposed. Trenton is at the point where a long narrow valley with continuous downward slope opens out into a wide alluvial plain, and where the rocky floor of the river suddenly descends below ocean level. It is here that the bulk of a gravel, swept down the upper valley, would, on meeting tidewater, stop in its course, and with its boulders be heaped up in a mass, immediately afterward to be cut through by the river. It was thus that a cliff of gravel 50 ft. high was here formed, the river having cut through the gravel instead of flowing upon it, as at Philadelphia. This explanation dispenses with the necessity of assuming, as some geologists have done, the submergence of the land by the ocean at the time of the deposition of the gravel. That Southern N. J. was at that time dry land is shown by the fact that this gravel at Trenton extends inland a few miles only, and having filled up a bar in the ancient flooded river, is bounded by hills of the older gravel which forms Southern N. J.

There are many facts indicating that the Trenton gravel is a true river gravel and not a glacial moraine, which are detailed in the present paper. The absence of glacial marks on the rocks, the stratified character of the gravel, the topography of its banks, the comparative amount of its erosian and the character of its materials, all point to the conclusion that it was deposited by a great flood of the river; and this, when taken in connection with the fact that it lies within a channel cut through gravel deposited by the waters of the melting glacier indicates a past glacial and comparatively recent age of the Trenton gravel.

The important bearing of this fact upon the antiquity of man on the Delaware, which, as will appear, depends directly upon the age of this gravel, is here apparent. Calculations based upon the erosive power of running water show that the time necessary for the river to cut through this gravel down to the rock need not have been long. On the

* Read before the A. A. A. S., Boston, 1880.

other hand, no such flood as deposited this gravel has ever occurred within the historical epoch. No such large boulders are ever now carried down the river. No modern rainstorms could cause such a flood. It is difficult to assign any other cause than that of a melting glacier. Yet such a glacier could hardly be the great Northern glacier, for these gravels are much newer than those of the Champlain epoch. There is here evidence of a second and more recent glacier in the Delaware valley.

The hypothesis of a *second glacial epoch* seems to explain all the facts observed. A similar period in Europe—the reindeer period—is supported by many facts. Should such a period not be traced in America, the date of the melting glacier must be made much more recent than that generally assigned.

The relics of man which occur in the Trenton gravel, and which were first found by Dr. C. C. Abbott, are of great interest. In shape, in size, in workmanship, and in material the implements here found are quite different from those used by the Red Indian. These "palæoliths" are imbedded at various depths in undisturbed Trenton gravel. There are two points which offer strong evidence that they are as old as the gravel. The first is the fact that modern Indian implements ("neoliths"), although abundant on the surface, never occur more than a few inches below it, and are never associated with the palæoliths, which are found at depths of from five to forty feet below the surface. This fact alone argues a different age for the two classes of implements. The second fact is that, when found below the surface, the palæoliths always occur in the Trenton gravel and never in older gravels. The writer has gone over, with Dr. Abbott, much of the ground where the implements occur, and it was very interesting to find that it was only within the limits of the Trenton gravel, previously traced out by the writer, that Dr. Abbot had found implements below the surface. Here, then, is the strongest probability, even if the implements were found on the surface only, that they belonged to and were of co-eval deposition with the river gravel.

The implements found in the river gravels of Europe are of similar type, though as a rule perhaps less rude. It is of interest to find that very similar implements have been used by the Eskimos, and it is probable that that race, now living in a climate and under conditions perhaps similar to those once existing in the Delaware, may have some kinship with the pre-Indian people of this river. The occurrence of bones of arctic animals in the Trenton gravel indicates a period of cold.

All the evidence now gathered points to the fact that at the time of the Trenton gravel flood, man, in a rude state, lived upon the ancient banks of the Delaware. If future archæological work can show a connection between this people and the Eskimos, it may be appropriate to call the period of the Trenton gravel and of this palæolithic people —a period perhaps following a second glacial age—the *Eskimo period*, a name more suggestive, and derived from a higher order of beings than that which gave the name "Reindeer Period."

While others have held that the occurrence of implements in the Trenton gravel indicates the existence of man in inter-glacial or even pre-glacial times, the writer believes that the investigations here described indicate the origin of man, at a time which geologically considered, is recent. Neither in the Champlain deposits, in the morainic material of the north, or in any older gravels have undoubted traces of man been discovered.

The actual age of the Trenton gravel, and the consequent antiquity of man in the Delaware, cannot be determined by geological data alone. It is the aim of this paper to define man's antiquity in relation to geological rather than to historical events. If, in showing that the Eskimo period is the last of the geological ages, it does not necessarily follow that it is by any means recent; it must be remembered, on the other hand, that its high antiquity is not proven by the facts thus far observed.

The conclusions to which the facts seem to point are briefly summarized as follows:

1. That the Trenton gravel, the only gravel in which implements occur, is a true river deposit of post-glacial age, and the most recent of all the gravels of the Delaware valley.

2. That the palæoliths found in it really belong to and are a part of the gravel, and that they indicate the existence of man in a rude state at a time when the flooded river flowed on top of this gravel.

3. That the data obtained does not necessarily prove, geologically considered, a vast antiquity of man in Eastern America.

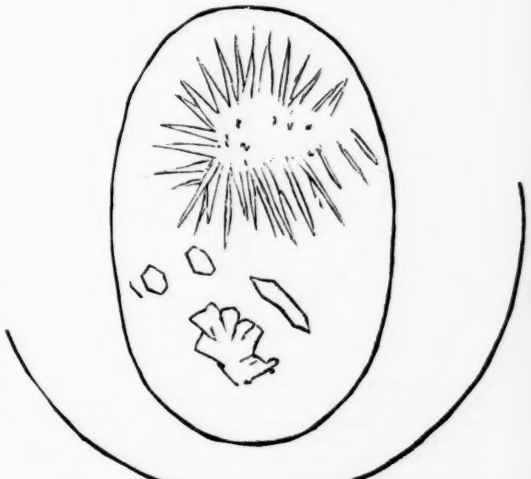
PYROLOGY, AND MICROSCOPICAL CHEMISTRY.

By W. A. Ross, Lt. Colonel, late R. A.

(1). In the year 1869, at Simla, India, having applied a trace of oxide of cobalt to a bead of boric acid before the blowpipe, I observed that, instead of dissolving, as I had been led to expect, small round black spots were formed, which, appearing perfectly round through the clear bead from every point of view, seemed to be spherides or balls. It was afterwards found that 14 oxides form such balls in boric acid, B. B., among which the most useful pyrological was that of *calcium*.

(2). I found, by the average of five assays, that the weight of the calcium borate ball, extracted by boiling water in which it is utterly insoluble, while the containing bead is rapidly dissolved—was a *constant multiple* of the weight of the calcined lime taken to make it, and that this multiple was 4.5. Thus, if w = the weight of the ball, the formula $\frac{w}{4.5}$ represented the quantity of pure lime in it. If *calcium hydrate* was taken, instead of calcined lime, a clear ball was still formed within the bead, which latter became opaque through opalescence, and as the balance showed that this ball also contained the above mentioned proportion of calcined lime, the opalescence was attributed to chemical water.

(3). Circumstances of a painful nature, which I need not here relate, prevented my going further into this matter for eight years, but I vainly solicited the Microscopical Society to take it up, and having been enabled this year (about two months ago) to purchase a binocular microscope, with polariscopic apparatus attached, I fitted a small spectroscope I had by me into one of its eye-pieces with cotton wool, etc., and renewed my examination of these boric acid balls.



TIN BORATE, (POLARIZED).

(4). Notwithstanding the undoubtedly chemical nature of the combination I have called "a calcium borate ball," the phenomenon of ball formation itself is obviously as much related to the subject of molecular physics as to chemistry, and seems explainable briefly as follows: All liquids having cohesion have, under circumstances of equilibrium,

a tendency to take the globular form, because it is the form in which the particles are at the least mean distance from the centre of gravity. As most oxides do not dissolve in boric acid, if the latter in its viscous state has very nearly the same specific gravity as the fused oxide, but is not miscible with it. This forms a ball with a tendency to occupy the centre of the bead, as oil does in water or water in oil, and the microscope now showed me, with reference to silica, that what I had supposed, looking through an ordinary lens, to be siliceous crystals adhering to calcium borate balls, formed by the mineral *Wollastonite* in boric acid were, in reality, thousands of *inner* transparent balls floating inside each calcium borate ball.

TUNGSTONE BORATE.

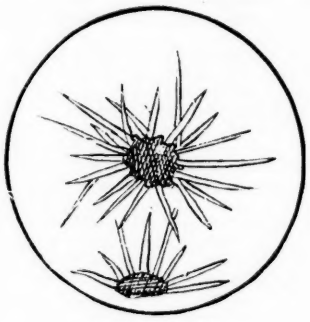
Similarly, therefore, it may be assumed, that a second borate, if it is not miscible with the first borate, but if it has a stronger cohesion, will take the place of an inner bead, and so it may be presumed with a succession of oxides.

(5). This assumption however demands the concession that each inner ball is a *single* borate, notwithstanding that it must obviously derive its boric acid from the containing borate ball, which, being ascertained, as in the case of calcium, to possess only its definite proportion of that acid, must in that case take the exact proportion of boric acid from the outer bead, which it has to give up to the inner ball.

TUNGSTONE BORATE.

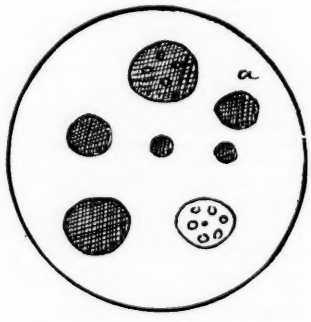
(6). To determine therefore, by actual experiment, if the inner ball in the case of *Wollastonite* was a silico-borate of calcium or a simple borate, I made a *large* calcium-borate ball with pure eggshell lime, in a bead of boric acid; extracted it by boiling the bead in water; made a bead on new platinum wire with the extracted ball; and, applying pure silica to it before the blowpipe, found that it would *not* now form balls within the calcium borate, although it would do so readily enough when the whole was surrounded by a bead of boric acid. On the contrary silica, zirconia, yttria, glucina, alumina, etc—all the "earths" in fact, which will not form balls *per se* in boric acid, dissolve rapidly and transparently in calcium borate when held as a bead by itself on platinum wire, but form balls within it when the whole is surrounded by a bead of boric acid, so that I submit the conclusion, that as regards silicate of lime, the inner balls may be composed of a new substance, SILICON BORATE, or alternatively silicate of boron.

(7.) I found that, as in the case of calcium hydrate (2) silica, however chemically pure, invariably gave off a certain amount of matter which caused opalescence in the boric-acid bead, *before* forming the inner balls above mentioned, from which phenomenon I argue that, if silicon borate is presumed to be formed, it is reasonable to infer that what we call silica is in reality *silicon hydrate*, and that a regular chemical interchange of components takes place.



TITANIUM BORATE.

(8.) Alongside the inner "silicon borate" balls in the large calcium borate balls afforded by the mineral *Wollastonite* (from a Freibourg Cabinet) in a bead of boric acid, are numerous spherical enclosures, exhibiting under a ¼-inch objective, a brownish amethystine color, similar to that imparted by manganese to borax held in an oxidising flame, and, on referring to the account of this mineral in Dana's "System of Mineralogy, 1877," I find that from .2 to .9 of manganic dioxide are supposed to have been detected in certain specimens by Stromeyer, Weidling, and Whitney. But manganese itself forms balls *per se* in a bead of boric acid, and in *no* case, within my observation, do ball-forming oxides produce these *inner* balls in calcium-borate; indeed, from the ordinary law of physics, such a circumstance is an impossibility, and I have mounted boric acid beads of the single colored balls derived from manganese dioxide, and manganese silicate with lime, beside a bead containing the triply-enclosed colored balls derived from *Wollastonite*, which I would submit therefore, may be due to a NEW EARTH of the silica type.

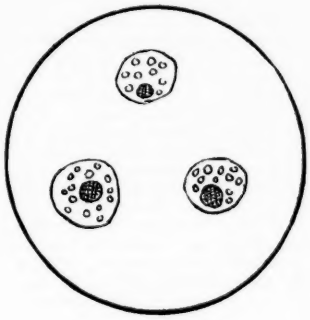


MANGANESE CALCIUM BORATE.

a. Manganese Borate—one Calcium Borate Ball accidentally present

(9.) I would only add here that the acid oxides, as WO_3, TiO_2, etc., which also fail to form balls *per se*, in boric acid, remaining there before the blowpipe in *fragments*, colored or not, as the case may be, form, instead of inner balls in

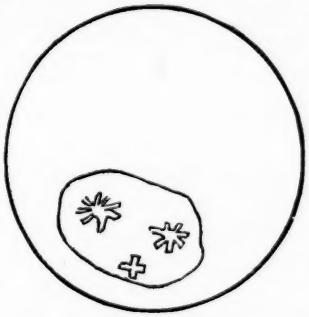
calcium borate, inner crystals, some of which are very beautiful and characteristic, especially by polarised light.



SILICON BORATE.

(10). I now feel that it was necessary to confirm these qualitative experiments by quantitative ones, and to establish the existence of this new substance, whatever it may be, which, eliminated from calcium hydrate, causes *opalescence* in a bead of boric acid before the blowpipe without at all lessening the due proportion of calcium in the borate ball formed—upon the reliable authority of the balance.

(11). As I invariably found that *pure chemically prepared silica* from Dr. Schuchartt, of Görlitz in Prussia, affords *per se* an orange flame before the blowpipe, and opalescence to a bead of boric acid containing a calcium borate ball (7); I chose this single substance, as left by the best analytical chemists in Europe to see if I could not resolve it—by *weighing* them—into two substances, and I submit that the results (the truth of which any chemist may easily ascertain for himself in his own laboratory by simply repeating these experiments) are sufficiently constant, under varying conditions, to warrant the immediate consideration of the unbigoted chemist.



URANIUM BORATE.

I. DR. SCHUCHARTT'S SILICA FROM GÖRLITZ.

	Mqrs.
(1). Si O_2 dissolved in a calcium borate ball, B. B...	2.5
(2). Weight of siliceous ball.....	18.5
(3). Weight of siliceous ball after extraction from 1st bead (2).....	30.0
(4). Weight of siliceous ball after extraction from 3d bead.....	26.7
(5). Weight of siliceous ball after extraction from 5th bead, when no more opalescence was given off.	23.0

II. POWDER OF PURE ROCK CRYSTAL.

(1). Si O_2 dissolved in a calcium borate ball, B. B....	2.5
(2). Weight of siliceous ball.....	22.3
(3). Weight of siliceous ball after extraction from 1st bead.....	30.7
(4). Weight of siliceous ball after extraction from 4th bead.....	27.8
(5). Weight of siliceous ball after extraction from 5th bead.....	24.8

III. THE SAME AS ABOVE.

(1). Si O_2 dissolved in a calcium borate ball.....	2.5
(2). Weight of siliceous ball	29.0
(3). Weight of siliceous ball after extraction from 1st bead	38.5
(4). Weight of siliceous ball after extraction from 5th bead	34.1

IV. MEXICAN OPAL (*nearly transparent*).

(1). Si O_2 dissolved in calcium borate ball.....	2.5
(2). Weight of siliceous ball	25.8
(3). Weight of siliceous ball after extraction from 1st bead	37.5
(4). Weight of siliceous ball after extraction from 3d bead	33.5
(5). Weight of siliceous ball after extraction from 6th bead	28.8

V. MEXICAN OPAL (*again*).

(1). Si O_2 dissolved in calcium borate ball.....	2.5
(2). Weight of siliceous ball	18.0
(3). Weight of siliceous ball after extraction from 1st bead	30.0
(4). Weight of siliceous ball after extraction from 4th bead	28.5
(5). Weight of siliceous ball after extraction from 5th bead	26.9

INCREASE OE WEIGHT.

Experiment I.

Mqrs. Mqrs. Mqrs.
Operation (5) — (2) = 23 — 18.5 = 4.5.

Mqrs. Mqrs. Mqrs.
Weight of Opalescent Matter = (3) — (5) = 30 — 23 = **7.**

Experiment II.

Operation (5) — (2) = 24.8 — 22.3 = 2.5.
Weight of Opalescent Matter = (3) — (5) = 30.7 — 24.8 = 5.9

Experiment III.

Operation (4) — (2) = 34.1 — 29.0 = 5.1.
Weight of Opalescent Matter = (3) — (4) = 38.5 — 34.1 = 4.4.

Experiment IV.

Operation (5) — (2) = 28.8 — 25.8 = 3.0.
Weight of Opalescent Matter = (3) — (5) = 37.5 — 23.8 = 13.7.

Experiment V.

Operation (5) — (2) = 26.9 — 18.0 = 8.9.
Weight of Opalescent Matter = (3) — (5) = 30.0 — 26.9 = 3.1.

NOTE.—The illustrations accompanying this article are made from rough sketches of crystals drawn, without camera luada from the microscopes. The shaded parts indicate color. The crystals were made by dissolving the oxide BB in a calcium borate ball held *as a bead* on platinum wire; crushing this bead to powder, and applying some of this powder BB to a boric acid bead.*

Mr. Barkas, of Newcastle-on-Tyne, Eng., has taken a very practical method of encouraging observational Astronomy, by offering to meet any of his townsmen who may be sufficiently interested and show them Jupiter, Saturn and other objects through an excellent telescope. From small beginnings great things often arise, and we should not be surprised if this offer, to be at a certain spot on a given night, led to the establishment of an observing society in Newcastle.

* In forwarding the above communication to "SCIENCE," Col. Ross states that it was originally prepared to be read at the recent meeting of the British Association.—(ED.)

TRANSFORMATION OF PLANORBIS.

A PRACTICAL ILLUSTRATON OF THE EVOLUTION OF SPECIES.

By Prof. Alpheus Hyatt.

II.

But we see that both the favored and unfavored found their appropriate spheres, and that even the deformities were perpetuated, and became distinctive of species.

Another characteristic which does not come under the dominion of any law of natural selection is the inevitable tendency to form an asymmetrical spiral in all the later occurring members of each series, whether progressive or retrogressive.

The lecturer then explained, by the aid of diagrams and a model, that the forms of shells are due to the successive imbricated layers built up by the border of the mantle in all mollusks. Secondly, that any force tending to compress one part of the secreting border more than another would occasion a narrowing of the imbricated layers of that part, and cause a twist or spiral to be formed. Thirdly, that the aspect of all the spirals examined shows that the shells are acted upon by such a force—gravitation, and in no other way can we account for their shape, and the obvious direction in which the compression of the border takes place.

The mathematical regularity of the spirals is explained if we admit the constant action of a universally distributed physical force upon the building up of the shell.

Diseased and outgrown, or old shells, were shown in order to enforce the fact that when an animal becomes weakened the shell shows its effect by the irregularities of the spiral. The excessively irregular forms of the oyster show that when the action of gravitation is in part eliminated the asymmetry is proportionately greater or less, and also that distortions occur in the internal soft body, as in the gills, and in the distribution and structure of the blood-vessels and mantle, which are quite different on the lower side of the adult oyster and upon the upper.

The oyster and all lamellibranchs grow *not in the direction of effort, but in that of least resistance.* The clam and the mussel were adduced to show this as well as the oyster. The forms of these shells are bilateral, but their anterior ends are compressed more than their posterior portions, therefore the valves grow faster towards the posterior than towards the anterior ends. Sooner or later when any soft-bodied animal lies habitually on its side, the originally bilateral or spherical form of the free animal must become distorted, as is the case with all attached animals, like the attached forms of protozoa, sponges, coelenterata, echinodermata, and so on. It is not difficult to show that their spiral, spherical, or bilateral symmetry is proportional, in all cases known to the speaker, to the amount of freedom in the growth of the parts; the freer the part the more symmetrical, the more attached or supported the more asymmetrical. Examples of shells like those of *Magilus antiquus* were cited in support of this view.

The attraction of gravitation is eliminated during the growth of this shell, by the coral which surrounds it; and the result, as also in the cases of many of the Vermetidæ, which receive a similar perfect support, is the formation of a wholly irregular tube, though the young are, while still free, provided with the ordinary turreted shell.

To show that the bilaterality of soft parts was produced by the attraction of gravitation on a soft growing body, the lecturer described several illustrations, especially the case of the Eolidæ, which have a coiled shell in the young, but lose this and become, during growth, perfectly symmetrical and soft-bodied. He also showed, that in no other way can we account for the extraordinary mixture of asymmetry in the shells and symmetry in the softer, free moving parts of the same animal among the Gasteropoda and other animals. The effects of heredity were also discussed, and it was shown that when a symmety, as distortion, was introduced, it occurred usually on the outer whorl, or during the latter stages of the growth, and that as time went on, this same characteristic appeared at earlier and earlier stages in the growth of successive descendants. The final effect of this law is the entire replacement of older ancestral characteristics by those which are newly introduced.

Thus the turreted asymmetrical spiral is found, as in the Steinheim shells, to gradually replace the more nearly symmetrical form of the immediate ancestors and the absolutely symmetrical form of the disc or shell, ovishell, as it is called, in all species. It was claimed that this law of heredity was absolute and independent, as one of the results of growth; and, that neither the variations, such as the formation of the asymmetrical spiral, nor its perpetuation and increase in successive generations of forms could be attributed to any law of natural selection.

The lecturer then, however, proceeded to show that the differences between the different series of shells could only be accounted for on the supposition of advantage and disadvantage, and took the ground that the Darwinian hypothesis applied perfectly to the explanation of the survival of only four distinct varieties out of the many which emigrated into the Steinheim basin, and tried to prove this by numerous instances quoted from Verrill and other authorities, showing that uniform physical causes must have a certain uniformity of result, which was not the case with the differences of the different series.

When, however, the action of natural selection had maintained the new differences for a certain length of time, until they had begun to be inherited, he claimed that it ceased to have any farther effect upon the organization.

Wherever the species might be found or whatever the surroundings there would be one thing absolutely certain; the forms during their growth would repeat the selected differences during their early stages of growth. In other words, the characteristics originally established by reason of their advantage or disadvantage in the battle of life, as soon as they become fixed in the organization, are no longer under the control of natural selection, which must vary with the immediate surroundings, but under that of heredity by acceleration.

The conclusions, besides those given in your report, were as follows:

"At the base of this conception of an animal lies growth."

Arising by growth through processes, which have been extensively studied, are, the bud, the egg, and all the phenomena connecting animals and plants according to the laws of heredity.

The action of growth and heredity, under the constant control of physical forces * gives the forms and many of the characteristics which distinguish a form from its immediate parents or ancestors, or from the forms occurring in other localities; in other words, the variations. The mutual action and re-action of animals and plants upon one another according to the laws of natural and sexual selection, etc., give it fixity in the organization to certain of these variations.

* Of course, in this view, the physical force is the immediate cause of every condition of symmetry of form, as well as of every variation not derived from inheritance. The animal, in other words, is looked upon as a plastic, growing organism, acted upon from outside by physical forces, which modify it perpetually, and upon which it re-acts by means of its powers of growth and heredity. The former tend to cause perpetual variation, the latter to preserve the type by renewing—"rejuvenating" it perpetually in each successive generation.

We cannot account for the suitability of organisms, and their adaptations to every situation in time, as the distribution on the existing surface of the earth, or for the results of experimental zoology, without acknowledging the paramount influence of physical forces.

Nor can we, on the other hand, account for the comparative invariability of the embryo for indefinite periods of past time, or for the preservation of the type in spite of the perpetual changes introduced by physical changes on the earth's surface, unless due weight be given to the reaction of the growth forces and heredity by acceleration, which tend to preserve original types comparatively unchanged.

An organism is not entirely at the mercy of the elements, but possesses a power which, within a certain sphere, acts not only for the preservation of its life, but also for the preservation of its own characteristics, and, through heredity, causes the perpetual recurrence of similar characteristics and similar changes, what are usually called parallelisms, in successive generations of genetically connected individuals, forms a species wherever they occur in time, and under whatever circumstances of local distribution upon the surface of the earth.

Manufacture of Factitious Butter in the United States.—A compilation from American and English sources shows that factitious butter contains only 1.823 per cent. of butyrine, caprine, caproine, and capryline, as against 7.432 per cent. in the natural product.—*Moniteur Scientifique.*

THE CUPRIFEROUS SERIES IN MINNESOTA.*

The paper of Prof. N. H. Winchell, State Geologist, of Minnesota, was a brief statement of the relations of that formation to the ranges of crystalline rock that form the northwestern border of the Lake Superior Basin. He concluded, by two lines of investigation, that the Cupriferous series is of the age of the New York Potsdam, and that it falls within the horizon of some part of that group which the Canadian geologists have designated the Quebec.

One line of argument related to an examination in the field of the stratigraphy, in which the sedimentary beds are seen to pass by metamorphic changes through various forms to fully crystalline rocks styled granite and gneiss. These crystalline rocks, which are spread over large areas, are intimately associated with the igneous rocks of the Cupriferous Series, from which, however, they are constantly distinguished by certain mineralogical differences. The writer also parallelized the igneous beds of the northwestern coast ranges with the Labradorite, or Norite, rocks of Canada, and suggested the possibility that the "Laureutian" Eozoon, said to occur in this terrane, may be of the age of the Lower Silurian.

ON COLOR BLINDNESS.*

By Dr. B. Joy Jeffries.

Dr. Jeffries first described the natural condition of the color-sense, and illustrated some of its peculiarities relating to color-blindness. The complimentary after-image of a color can be readily seen by gazing at the red setting sun, when, if we turn our eyes to the east, we shall see a *green* rising one. Looking steadily at a yellow spot on white, and turning away, we see a blue one, etc. After looking intently at the red or green light on a railroad or vessel, one cannot help momentarily seeing the reverse color. The centre of the retina has the greatest power of form-perception; we must fix our eye steadily to see anything very distinctly. The same with color. All colors fade in intensity outward from the centre of the retina. In a central zone we can distinguish all three of the colors now considered primary, viz., red, green, and violet. In a zone outside of this our red perception fails, and in the outer portions still of the retina green fails, and we see blue or violet only. Now, we have *red, green*, and *violet* blindness, resembling, so to speak, the conditions of these zones. This must not, however, be too strictly construed. Color-blindness may be best described thus: Those who are red or green (one involving the other) or violet-blind see all objects having these colors as gray or grayish in the proportion in which they are color-blind and the depth of the pigment. A color mixed with their faulty one will be, so to speak, *muddy*: Many thousands of examinations have been made all over the world, with the same result. He has tested 17,695 males, finding 739 color-blind in greater or lesser degree, viz., about 4 per cent. In females it is very rare, which, however, their familiarity with the colors does not account for. He tested 13,893 females, finding only ten color-blind. Age, race, color, education, condition of civilization—all seem to have no effect, as tests have been now made from the north pole to the equator, and throughout Europe and America. It is congenital, and largely hereditary, It may be artificially produced by putting a person in a cataleptic or hypnotic state; also those color-blind who can be put in this state can be temporarily relieved of their defect. It may be cured by tobacco and alcohol poisoning, by injuries affecting the head, and by disease. It is a symptom of some brain disease of constitutional origin.

It can be palliated by gas light, or by looking through pale lemon-colored glass, or by looking through a solution of the aniline dye called fuchsine. All this does not cure, but simply changes the relations of light and shade for the color-blind, by which alone they distinguish their faulty colors. The reader briefly described how difficult it was formerly to detect color-blindnes, and referred to his manual in explanation of the manner in which persons affected escape. Thanks to recent observers and workers in the field we now have methods which are simple, and readily and quickly carried out by competent experts.

* Read before the A. A. A. S., Boston, 1880.

These facts have led the United States Government to undertake its control in the army, navy, and marine hospital service. Unusual examination of seamen is not yet compulsory. Its great value to the sailor was particularly explained. Standard tests and standard powers of sight and color-perceptions are not yet determined by the United States. An International Commission to determine these has been proposed in a bill now before Congress. The future value of such a commission was explained, and the audience urged to assist in having the system carried out.

As to the railroads of the country, Dr. Jeffries quoted from his book, now a United States manual: "The difficulties are very great. Here the interests and the safety of the community have to contend with ignorance, prejudice, pecuniary considerations and incredulity born of supposed immunity from danger." This has proved most true, and even at this date, three years and a half since he, in this same room, called public attention to the danger from color-blindness, but one State, Connecticut, has passed laws controlling color-blindness and visual defects among railroad employés. And here in this State most violent attempts have been made to prevent the action of the law in protecting the community, even politics being introduced.

The practical tests, approved of over the world and recommended at the International Medical Congress at Amsterdam, September, 1879, and directed by the Connecticut Board of Health in charge of the control, were then thoroughly shown and explained. Practical illustration was also given the audience by a color-blind gentleman who kindly consented to exhibit his infirmity in the cause of science. These tests were Holmgren's with the colored worsteds (used by Dr. Jeffries in our public schools and the association), Donders and Daae's modification of this method, Stilling's pseudo-chromatic cards, Woinow's disk, Pflüger's letters, and finally Donders' method with reflected light and transmitted light, and Holmgren's with colored shadows,—these last two being for the purpose of determining the quantitative color-sense so necessary in deciding the fate of a railroad employé or pilot. The simple, practical use of these methods in the hands of competent experts was shown and proved in testing thereby the color-blind present. Dr. Jeffries explained in detail how theoretical was the attempt to decide the color-sense by lanterns and flags used on land or sea, and how readily mistakes would thus be made. The worsted test can, by competent experts, be quickly made in the paymaster's car, for instance, whereby no man is taken from his duty. The color-blind can thus be sorted out, and subsequently re-examined with these additional tests as a means of control, and to exhibit their precise defect to those in authority. During and after the reading of the paper color-blind gentlemen present were exhibited, to their astonishment and to that of the bystanders. All present were asked if convinced by what was shown of the danger, to exert their influence in the cause of control of color-blindness. Dr. Jeffries stated in conclusion that he had hoped to have been able to touch upon the most interesting point of the development of the color-sense and the education of our color-perception. He was, however, only able to briefly refer to the work going on of the study of color development, and particularly the contributions to it by his friend Dr. Hugo Magnus, of Breslau. Dr. Jeffries' work in testing all the Boston school-children showed, as it has elsewhere, the great ignorance on the part of males of color-names, aside from color-blindness. He exhibited Dr. Magnus' color-chart for teaching children colors and their names, which received a diploma of honor from the International Medical Society at Amsterdam. The use of this he explained, and said he was engaged with Mr. Prang in its introduction into this country among our schools, both private and public. The great purpose of this special work being to teach the child to associate with the word the color and the color sense, as well as the mere color names.

Occurrence of Ozone on Evaporation of Different Liquids.—A few drops of ether or alcohol are let fall upon a paper equally moistened with cadmium iodide-starch solution, and the volatile liquids set on fire. After their cooperation the paper is found to be turned blue from the formation of ozone.—*Polyt. Notizblatt.*

AN INVESTIGATION OF THE VIBRATIONS OF PLATES VIBRATED AT THE CENTRE.

By Professor Thomas R. Baker.

Since the publication of the paper under the above heading we have received from Professor Baker two drawings illustrating the same, which we now produce.

The first, Fig. 1, shows Professor Baker's method of producing the sand pictures, useful for class illustration:

Fig. 1.

Most of the plates used were window panes of various shapes and sizes, they were vibrated by rubbing an attached glass rod. The tubes, which were about $\frac{3}{16}$ of an inch in diameter and 20 inches long, were attached at right angles to the face of the plate with sealing wax. The support for the plate was a rubber cap, the common lead pencil eraser, fitted on the end of a post projecting from a disk of lead. A short rubber-capped lead pencil fixed upright in a wooden block answers the purpose just as well.

The plate was balanced on the support, the tube standing upright, and held loosely between the thumb and forefinger of the left hand. Then catching the tube between the moistened thumb and forefinger of the right hand and rubbing downward the vibrations of the plate were produced.

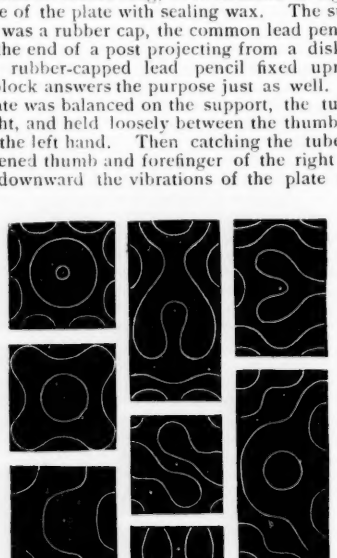


Fig. 2.

Fig. 2 represents copies of various sand pictures thus produced. He states:

"The figures were copied by placing the plate over paper which had been wet with a solution of potassium bichromate and dried in the dark. The plate and paper were exposed to diffused light, or to the vertical rays of the sun. The paper not hid by the sand soon darkened, and when this change had taken place the plate was removed and a lead pencil run along the bands of lighter colored paper representing the sand lines. This paper was then placed on white paper, and the figures copied by pressure. About 150 sand-figures were copied and traced."

For a summary of the facts derived from these experiments we refer our readers to Science, Vol. I., No. 13, September 25th, 1880, page 157.

FIELD WORK BY AMATEURS.*

By Helen Harelin Walworth.

It is announced, I believe, that one of the aims of the American Association for the Advancement of Science is to make Natural Science popular, to encourage its pursuit among all classes of people. It is because I have such an understanding of its aims that I presume to speak a word in behalf of the class who love science, yet can give to it but a limited portion of their time and thoughts.

Such a class of persons are important factors in the development of every department of knowledge and art. The professor, the artist, the specialist may have higher aims; they certainly do more thorough work, yet they would scarcely be understood, appreciated and encouraged if there did not exist the intermediate class who admire, applaud and exhibit the work they cannot themselves perform.

I therefore deprecate the scorn with which the professional too often contemplates the dabbler in his specialty, as he will perhaps designate the amateur. "A little knowledge is a dangerous thing" only when it is pretentious. A mere elementary knowledge of any natural science is a proposition from which reason starts; it is a foundation on which thought builds, and a height from which imagination takes its flight. It is an education in all other knowledge, because it demands attention, observation and accuracy with well defined expression.

How can the popular interest in science be stimulated and increased? A majority of educated people shrink with aversion from the memory of tasks performed at school. The bare mention of a natural science recalls pages of unpronounceable words and incomprehensible classifications. Yet, if a practical geologist or botanist will take any three of these individuals into the field with him and beguile them into breaking rocks or gathering flowers scientifically, two out of every three will be delighted with the occupation, and will strive to recall the classical names which inspired them with disgust while they were merely theoretical. It is then only while science is an abstraction that it repels; render it practical and it invariably attracts.

In every city and village of our country we find numerous clubs and societies devoted to special objects of literature and art, and a few to science. These last are rare, they would be numerous and active if slight encouragement were given to them by those who have the ability to guide and direct. Such clubs and associations should begin with a short and well directed course of reading, accompanied, if possible, by a few interesting lectures as a preparation for field work which should not be delayed through timidity or a feeling of ignorance. A few visits to the field by a geological club will serve to arouse enthusiasm, and inspire a desire for research, which months of reading would not accomplish. It cannot be urged that many live in localities where there is nothing to study, for I believe it may be safely stated that uninvestigated scientific facts lie over and under every square mile of the United States. Yet I have heard the members of a geological club, who studied exclusively in the class-room, make such a plea. When visiting their city I said to one of them, "What rocks have you in this vicinity?" The person addressed looked at me with unqualified surprise and answered, "We have none." I exclaimed, "you have a river and hills, and many railroad cuttings, the foundation of things must be visible somewhere." But this individual insisted that there was absolutely nothing to examine within walking or driving distance of that city. There is, of course, a difference in varying localities. In Davenport, Iowa, where there is now a well-established Academy of Science, located in its own fine building, and displaying a great museum, a few years ago there were but half a dozen persons who met in a hired

* Read before the A. A. A. S., Boston, 1880

room to talk informally about science. They soon, however, began collecting and investigating in the suburbs of their city; it is, as you know, the region of ancient mounds. Their discoveries have been remarkable and valuable.

In Saratoga Springs, where I reside, we have, in a limited way, an interesting geological region, and we have an active Field Club. It labors under disadvantages, having had no regular instruction, and no course of lectures, but it has been assisted by two gentlemen who have had some experience in geological research. As this club is now established upon an apparently permanent basis, some account of its efforts may not be amiss. There are between thirty-five and forty members, the larger number studying geology; a few botany, and others, who are studying art, accompany these to sketch from nature. This community of interest among those who are pursuing different studies has the advantages of economy in the hiring of vehicles and in the purchase of instruments like the microscope, which can be used in common.

The Saratoga Field Club makes excursions into the country every Saturday, when the weather is favorable for field work; they also have in-door meetings once a week, to compare and examine specimens; papers are then read on subjects relating to special objects of study and discussion, and conversation concerning them is encouraged. Meetings are also held during winter preparatory to the summer work.

We have in Saratoga the rocks of the Laurentian, the lower Silurian of the drift, the Champlain and Hudson river periods. But in the Laurentian granite alone there is an endless variety for those who are interested in minerals. Then, too, one experiences a certain awe in handling the oldest rocks that formed a boundary of the world's first continent. The gloom of that almost lifeless age seems still to creep along the dark, stout foliage that strives to cover the baldness of these venerable rocks. Worn and ground by the action of ages they display few picturesque forms, but strength and endurance seem moulded into shape among their rounded hills, while nestling among their unattractive gray shadows are found the garnet, the chrysoberyl, the tourmaline and other beautiful gems. The Potsdam sandstone lying above the granite, shows great variety and beauty of color, and Ruskin says very justly, "that nature tempts us, like foolish children as we are, to read her books by the pretty colors in them." The ripple marks and glacial scratches of this rock are also countless and interesting. The calciferous sand-rock coming next in succession, and upon which the western half of our village rests, is in many places brilliant with crystals and finely-marked with Fucoids; it bears also whole acres of the marvelous concentric Stromotopara, which is peculiar to this vicinity. The Trenton limestone, next above this is, as usual, rich in fossils, and an afternoon amid its quarries will render the members of the Field Club oblivious of heat or cold or fatigue in their search for Erinoids, Brachiopods and Trilobites. Such interest is scarcely diminished in their laborious wanderings in other directions among the Hudson river slates and shales for the rarely found Graptolites. The morains and pebble-laden hills of the drift period are sought out and discussed. The sands of the Champlain, and the terraces of the Hudson river periods are subjects for thought and surmise as we ride over the country toward some definite object of investigation. The great geological fault which has given birth to our justly renowned mineral springs, coming forth as they do from the hidden fossil oceans of the buried centuries, stimulates us to ponder and to inquire. Yet for years most of the members of this club have walked blindly through these treasures, seeing, but not observing; knowing, but not seeing. A new world has been opened to them, and this world of nature and of science would be a revelation to hundreds of others if they were induced to engage in out-of-door studies.

The public mind has been awakened to an interest in science by means of the popular lectures delivered by men of acknowledged fame, and also through numerous popular publications. These have been a preparation for field work which can now be pursued with enthusiasm and profit. A search for geological facts in the fields affords an admirable means of self-discipline. In the beginning each one sees all that he seeks and believes that all he sees is of immense value, or he goes to the other extreme and pronounces everything worthless. He will be vexed with himself, crushed and mortified by turns, but each blunder will be an important lesson, and soon he will begin to discriminate, to learn and to search, until he finds himself, like the hunter in pursuit of game, eager, excited, and ever ready for a new chase.

When the guidance of a professor of Geology cannot be procured, much may still be done with the use of proper text-books, and the State Geological Surveys, especially if there are a few men or women in the association who have some experience in field work. In every community a few gentlemen will be found who possess such knowledge. It is a deplorable fact that few women possessing such knowledge can be found in any community, except, of course, in Boston. I say deplorable, because scientific training is, of all others, that which women need to correct the defects which, as a class, they display—defects which have become inherent through continuous superficial training. In this case like must cure like, for it will require several generations of women, gradually trained to scientific methods of thought and investigation, to eradicate the slipshod mental habits of the women of to-day. A few are struggling toward better and clearer ways, but the difficulties to be overcome prove the low standard of their starting point. Is it right that woman should be ignorant of the scientific facts embodied in the useful and beautiful things she handles? If these facts are of value to the world they are of value to women individually.

Invite women, then, to enter upon this field of labor, and science will gain thereby. Enlist the enthusiasm, the self-sacrifice and vitality of women in the cause of science, and a new principle will stir the remotest members of the body of scientific knowledge.

The effect of this labor upon the lives of women is beyond calculation. Where they are now weak, both physically and mentally, they will become vigorous and strong; where they are complaining and sentimental, they will grow cheerful and wise. Their restless longings will move into healthful channels, and they will learn to think, to observe, and to perform with accuracy and deliberation. They will discover that the ability to learn and to do is not a mere knack to be caught, but that it is the result of continuous and pains-taking labor.

Believing, as I do, that a practical knowledge of natural science will do more for the advancement and emancipation of woman than any laws that can be made, or any rights which can be granted to her, I appeal to the learned gentlemen of this association to invite and encourage women to labor in the various departments of scientific investigation.

The progress of woman depends on the exercise and discipline of her mental powers and the proper expenditure and economy of her physical powers. Both means are to be obtained mainly through a knowledge of the natural sciences, and they will take and retain their hold upon her more readily by means of out-of-door work.

There are also many men engaged in the professions and in business who would make time for open air excursions if they thought a study of natural objects feasible. In such studies of local geology the amateur may, by chance, make valuable discoveries, and he may in time become enlisted as an enthusiast and specialist. Goethe says that in science "treatment is nothing, all effect is in discovery; every new phenomenon that is observed is a discovery, and every discovery a property." If, then, it is allowable and desirable for amateurs to study science practically, it is important for them to receive suggestions and instruction from professors and specialists. In botany several American publications have been issued, which serve as admirable guides for such persons. In geology I know of but one popular book on field work. That is an English publication; we need one especially adapted to American geology. A series of articles published in one of the popular magazines, and bearing a name of authority, would give a wholesome impetus to this work, and would reach many persons who desire information concerning it. These vague desires and feeble reachings after such knowledge should be noticed and cherished, for in these there may exist some of the future discoveries and triumphs of science.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

THE FOURTH FORM OF MATTER.

To the Editor of SCIENCE:

Science to-day recognizes but three forms of matter, viz.: the solid, the liquid, and the gaseous; though the existence of another form still more tenuous than the gaseous has been suspected by some distinguished men, and among them FARADAY, prince of scientists.

FARADAY, in 1819, delivered a series of lectures before the Royal Institution, on the general properties of matter, in one of which, entitled, "On Radiant Matter," he thus expressed himself: "If we conceive a change as far beyond vaporization as that is above fluidity, and then take into account also the proportioned increased extent of alteration as the changes rise, we shall, perhaps, if we can form any conception at all, fall not far short of *radiant matter*." Later he pointed out that matter may be classed under four states, viz.: solid, liquid, gaseous and radiant, and demonstrated the *probability* of the existence of the last. So far went FARADAY, and no one who has ever attempted it has gone any farther.

This "fourth" form can be accepted only upon a demonstration that is beyond question or doubt. It must be as positively distinct from the gaseous as that is from the liquid, or as the liquid is from the solid, and its existence must be more than inferential or imaginary. Its effects on a sufficiently large scale must be seen or felt. Then will men recognize it as the "border-land" of matter, beyond which only spirit can be.

That such a form of matter exists can to-day be confidently asserted, for modern science is demonstrating it in many ways. Around and about us, and known to all men, is an element that apparently satisfies every requirement; an element more efficient than steam, vapor, or gas; having numerous and varying forms, and with as many names; an element that is generically called electricity. It is the chief study of scientific men at present. It is matter; subtle, swift, powerful, manifold in operations, invisible, and with the strange power of multifold transformations. It passes as a *substantial* thunderbolt at one moment, and at the next is diffused into almost infinite tenuity. In the electrical fireball it moves at times slowly; in the telegraph with inconceivable velocity; in the cyclone with utmost power and regularity; and in such incalculable phenomena as that of the Minnesota flouring mills disaster, with marvelous explosiveness. As radiant matter it is everywhere present, as far as we can discover. Some idea of the ever-present and ever-ready state of this element is conveyed in the fact that not only every body and substance, but almost every method of dealing with substance manifests its presence. Earth in every part, and air, are pervaded by this mighty universal power, strong as gravity itself.

PROF. WILLIAM E. CROOKES, of the *Royal Society, London*, has sought for this kind of matter "in the shadowy realm between the known and unknown," which for him, he says, "has always had peculiar temptations." The shadowy realm of imagination cannot be fruitful in furnishing the substantial and reliable data required in scientific investigation. He has, however, inadvertently contributed to the resources of science by exhibiting some striking experiments that show the peculiar action of electricity *in vacuo*. In claiming to have discovered his "fourth form," in the imagined play of imaginary molecules or atoms, while at the same time having in use an electric battery, competent to all the phenomena, he appears to rather speculate than reason. As well claim that the spirits are at work in his tubes. Electricity in this case appears too subtle for its master.

It is, therefore, to the radiant, all-pervasive electrical or magnetic matter, that we must look for a candidate for the high honor. FARADAY'S classification may henceforth stand as legitimate, viz.: solid, liquid, gaseous, radiant. The latter may be considered as dominating and interpenetrating all the rest. It is the form in which life and motion reside, or through which they are communicated. Electricity now appears to be the underlying form, or substratum, out of which come light, heat, magnetism, gravity, etc., and recent experiments of EDISON, BELL, COULON, and others show the fact that most wonderful transmutations belong to this matter of the "radiant form."

It may be said that scientists are not altogether agreed as to the materiality of electricity, yet it *is* material to the consciousness of every thoughtful man. But, if matter, to which of the forms does it belong, solid, liquid, or gas? or do we find it in all? Plainly it transcends in qualities and powers each and all the recognized forms and is beyond their definition. No one would declare it to be solid, nor would it be called gaseous, and though it may pass under the definition, "A *power* in nature styled the electric *fluid*," yet it is not scientific to call a fluid one of *the powers of nature*. It were more satisfactory to relegate it to the realm of spirit-force at once; but what scientist would do that? We shall yet find in a fourth or radiant form, the true interpretation of all the most mysterious phenomena of matter.

HENRY RAYMOND ROGERS, M.D.,
Dunkirk, N. Y., Oct. 11, 1880.

COMPARATIVE ZOOLOGY.

That the extinct fish-like reptiles known as Ichthyosauri, in some cases, at least, produced living young, is the conclusion of a Report upon the subject to the recent meeting of the British Association by Prof. Seeley, a brief abstract of which is given in *Nature* for September 16. In several specimens, notably those at Tubingen, the perfectly preserved young are enclosed within the ribs of the parent. In estimating the zoological significance of viviparity it should be borne in mind that while it is constant among the mammals, some sharks are oviparous and others viviparous, and that among serpents not only does this diversity of function exist, but even some species seem to be variable in this respect. B. G. W.

NOTES AND QUERIES.

[2.] WHO first used the phrase "Foramen of Monro"? In a paper entitled "The Foramina of Monro: Some Questions of Anatomical History," in the Boston *Medical and Surgical Journal* for August 12, Prof. B. G. Wilder demonstrates, upon various lines of argument, that the foramina were named in honor of Alexander Monro, *secundus*, and not *primus*, as stated by some writers. It is now desirable to ascertain by whom the name was introduced into the anatomical vocabulary. Monro's "Observations upon the Nervous System" was published in 1783, hence the phrase must have originated at some later date. MEDICUS.

A REMARKABLE solar protuberance was observed by M. Thollon, on August 30, at the Paris Observatory. About 11 A.M. he saw it rise from the eastern limb, as a vertical, thin, and very brilliant, luminous jet. The displacement of the line in C in the spectroscope corresponded to a velocity of 35 kilometres per second, and the protuberance rose to a height equal to half the solar radius, or about 343,000 km. After rising, it enlarged to prodigious dimensions, its brightness sensibly diminishing especially near the base. By about 1 P.M. it had become hardly visible. A curious fact is, that while the lower and middle part of this protuberance gave a deviation of the line C towards the violet, the top presented a nearly equal deviation towards the red.